surface that reflects light coming from said first reflecting surface, at least one of said first and second reflecting surfaces being a concave reflecting surface, for forming an intermediate image from an object of a first plane surface; and

a refraction type optical system for forming a second image onto a second plane surface which is substantially parallel to said first plane surface,

wherein, at least one of said first and second reflecting surfaces forms said intermediate image at an off-axis position, and said catadioptric type optical system and said refraction type optical system are disposed on a single linear optical axis.

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REMARKS

Favorable reconsideration of this application, as amended, is respectfully requested.

Claim 41 has been cancelled in response to the objection thereto.

Claim 17 has been cancelled, thereby overcoming the objection to the drawings. The subject matter of Claim 17, with the last paragraph modified to avoid reference to an

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aperture portion, has been incorporated into dependent Claim 18. Claims 19-28 have been made dependent upon Claim 18.

The allowance of Claims 17-28 is noted with appreciation. Claims 18-28 are now believed to be clearly allowable.

Claims 30, 31, 33-38, 44 and 46-48, which were merely objected to, have been rewritten in independent form and are now allowable.

With regard to the rejection under 35 U.S.C. § 102(b) based on Foo ('207), independent Claim 29 now recites, inter alia, a refraction type optical system for forming an image of light coming directly from the second reflecting surface, onto a second plane surface which is substantially parallel to the first plane surface. In Foo, light from the second reflecting surface (20c) is reflected several times before it reaches the refraction optical system 50. Thus, the refraction type optical system does not form an image of light coming directly from the second reflecting surface. Accordingly, Claim 29 and dependent Claims 32, 39, and 40 distinguish patentably from Foo.

Independent Claims 42 and 50 recite, inter alia, that the catadioptric optical system and the refraction type optical system are disposed on a single linear optical axis, thereby

distinguishing Claim 42, dependent Claims 45 and 49, and Claim 50 from Foo (Cf. Claim 30).

Claim 50 also distinguishes from Matsumoto ('028), upon which a rejection of Claim 50 under 35 U.S.C. § 102(b) was based, in the same manner.

With regard to the rejection of Claim 50 on Matsumoto, it is also noted that light does not pass the first reflector (M1/M3), but is reflected thereby.

A marked-up copy of the amended claims is attached.

This application is now believed to be in condition for allowance.

A check for $1,260.00 is attached in payment of the required fee for excess claims.

The Commissioner is hereby authorized to charge to Deposit Account No. 50-1165 any fees under 37 C.F.R. §§ 1.16 and 1.17 that may be required by this paper and to credit any overpayment to that Account. If any extension of time is required in connection with the filing of this paper and has

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not been requested separately, such extension is hereby requested.

Respectfully submitted,

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March 6, 2002

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MARKED-UP VERSION OF THE CLAIMS (APPLN. NO. 09/615,081):

18. (Amended) A catadioptric optical system [according to Claim 17] comprising:

a catadioptric type optical system, which includes a lens element, a first reflecting surface and a second reflecting surface that reflects light coming from said first reflecting surface, at least one of said first and second reflecting surfaces being a concave reflecting surface, for forming an intermediate image from an object of a first plane surface; and

a refraction type optical system for forming a second image onto a second plane surface which is substantially parallel to said first plane surface;

wherein, light coming from said second reflecting surface passes out of an effective diameter of said first reflecting surface, and said catadioptric type optical system and said refraction type optical system are disposed between said first plane surface and said second plane surface, and

wherein said catadioptric type optical system and said refraction type optical system are disposed on a single linear optical axis.

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19. (Amended) A catadioptric optical system according to Claim [17] 18, wherein said catadioptric type optical system includes a lens group including at least one positive lens, and said refraction type optical system includes an aperture diaphragm.

20. (Amended) A catadioptric optical system according to Claim [17] 18, wherein an exit pupil of said catadioptric optical system is substantially circular.

21. (Amended) A catadioptric optical system according to Claim [17] 18, wherein the following condition is satisfied:

$0.04 < |fM1| / L < 0.4$

wherein fM1 is a focal length of said concave reflecting surface of said first or second reflecting surface, and L is a distance along the optical axis from said first surface to said second surface.

22. (Amended) A catadioptric optical system according to Claim [17] 18, wherein the following condition is satisfied:

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$0.6 < |\beta M1| < 20$

wherein $\beta M1$ is a magnification of said concave reflecting surface of said first or second reflecting surface.

23. (Amended) A catadioptric optical system according to Claim [17] 18, wherein the following condition is satisfied:

$0.3 < |\beta 1| < 1.8$

wherein $\beta 1$ is a magnification of said catadioptric type optical system.

24. (Amended) A catadioptric optical system according to Claim [17] 18, wherein said catadioptric type optical system includes a lens group including at least one lens element whose surface is asymmetric, and said refraction type optical system includes at least one lens element whose surface is asymmetric.

25. (Amended) A catadioptric optical system according to Claim [17] 18, wherein at least one of said first and second reflecting surfaces is a concave reflecting surface

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that corrects positive Petzval sum created by said lens element.

26. (Amended) A catadioptric optical system according to Claim [17] 18, wherein the catadioptric optical system has both-sides telecentricity.

27. (Amended) A catadioptric optical system according to Claim [17] 18, wherein said refraction type optical system includes two kinds of glass material.

28. (Amended) A projection exposure apparatus, wherein a catadioptric optical system according to Claim [17] 18 projects a predetermined pattern on a mask onto a photosensitive substrate.

29. (Amended) A catadioptric optical system comprising:

a catadioptric type optical system, which includes a lens element, a first reflecting surface and a second reflecting surface that reflects light coming from said first reflecting surface, light coming from said second reflecting surface passing said first reflecting surface off-axis thereof, at least one of said first and second reflecting surfaces being a

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concave reflecting surface, for forming an intermediate image from an object of a first plane surface; and

a refraction type optical system for forming an image of light coming directly from said second reflecting surface, [a second image] onto a second plane surface which is substantially parallel to said first plane surface,

wherein, said catadioptric type optical system and said refraction type optical system are disposed between said first plane surface and said second plane surface.

30. (Amended) A catadioptric optical system [according to Claim 29] comprising:

a catadioptric type optical system, which includes a lens element, a first reflecting surface and a second reflecting surface that reflects light coming from said first reflecting surface, light coming from said second reflecting surface passing said first reflecting surface off-axis thereof, at least one of said first and second reflecting surfaces being a concave reflecting surface, for forming an intermediate image from an object of a first plane surface; and

a refraction type optical system for forming a second image onto a second plane surface which is substantially parallel to said first plane surface,

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wherein, said catadioptric type optical system and said refraction type optical system are disposed between said first plane surface and said second plane surface, and

wherein said catadioptric type optical system and said refraction type optical system are disposed on a single linear optical axis.

31. (Amended) A catadioptric optical system [according to Claim 29] comprising:

a catadioptric type optical system, which includes a lens element, a first reflecting surface and a second reflecting surface that reflects light coming from said first reflecting surface, light coming from said second reflecting surface passing said first reflecting surface off-axis thereof, at least one of said first and second reflecting surfaces being a concave reflecting surface, for forming an intermediate image from an object of a first plane surface; and

a refraction type optical system for forming a second image onto a second plane surface which is substantially parallel to said first plane surface,

wherein, said catadioptric type optical system and said refraction type optical system are disposed between said first plane surface and said second plane surface,

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wherein said catadioptric type optical system includes a lens group including at least one positive lens, and said refraction type optical system includes an aperture diaphragm.

33. (Amended) A catadioptric optical system [according to Claim 29] comprising:

a catadioptric type optical system, which includes a lens element, a first reflecting surface and a second reflecting surface that reflects light coming from said first reflecting surface, light coming from said second reflecting surface passing said first reflecting surface off-axis thereof, at least one of said first and second reflecting surfaces being a concave reflecting surface, for forming an intermediate image from an object of a first plane surface; and

a refraction type optical system for forming a second image onto a second plane surface which is substantially parallel to said first plane surface,

wherein, said catadioptric type optical system and said refraction type optical system are disposed between said first plane surface and said second plane surface, and

wherein the following condition is satisfied:

$0.04 < |fM1| / L < 0.4$

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wherein fM1 is a focal length of said concave reflecting surface of said first or second reflecting surface, and L is a distance along the optical axis from said first surface to said second surface.

34. (Amended) A catadioptric optical system [according to Claim 29] comprising:

a catadioptric type optical system, which includes a lens element, a first reflecting surface and a second reflecting surface that reflects light coming from said first reflecting surface, light coming from said second reflecting surface passing said first reflecting surface off-axis thereof, at least one of said first and second reflecting surfaces being a concave reflecting surface, for forming an intermediate image from an object of a first plane surface; and

a refraction type optical system for forming a second image onto a second plane surface which is substantially parallel to said first plane surface,

wherein, said catadioptric type optical system and said refraction type optical system are disposed between said first plane surface and said second plane surface, and

wherein the following condition is satisfied:

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$0.6 < |\beta M1| < 20$

wherein ßM1 is a magnification of said concave reflecting surface of said first or second reflecting surface.

35. (Amended) A catadioptric optical system [according to Claim 29] comprising:

a catadioptric type optical system, which includes a lens element, a first reflecting surface and a second reflecting surface that reflects light coming from said first reflecting surface, light coming from said second reflecting surface passing said first reflecting surface off-axis thereof, at least one of said first and second reflecting surfaces being a concave reflecting surface, for forming an intermediate image from an object of a first plane surface; and

a refraction type optical system for forming a second image onto a second plane surface which is substantially parallel to said first plane surface,

wherein, said catadioptric type optical system and said refraction type optical system are disposed between said first plane surface and said second plane surface, and

wherein the following condition is satisfied:

$0.3 < |ß1| < 1.8$

wherein ß1 is a magnification of said catadioptric type optical system.

36. (Amended) A catadioptric optical system [according to Claim 29] comprising:

a catadioptric type optical system, which includes a lens element, a first reflecting surface and a second reflecting surface that reflects light coming from said first reflecting surface, light coming from said second reflecting surface passing said first reflecting surface off-axis thereof, at least one of said first and second reflecting surfaces being a concave reflecting surface, for forming an intermediate image from an object of a first plane surface; and

a refraction type optical system for forming a second image onto a second plane surface which is substantially parallel to said first plane surface,

wherein, said catadioptric type optical system and said refraction type optical system are disposed between said first plane surface and said second plane surface, and

wherein said catadioptric type optical system includes a lens group including at least one lens element whose surface is asymmetric, and said refraction type optical system

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includes at least one lens element whose surface is asymmetric.

37. (Amended) A catadioptric optical system [according to Claim 29] comprising:

a catadioptric type optical system, which includes a lens element, a first reflecting surface and a second reflecting surface that reflects light coming from said first reflecting surface, light coming from said second reflecting surface passing said first reflecting surface off-axis thereof, at least one of said first and second reflecting surfaces being a concave reflecting surface, for forming an intermediate image from an object of a first plane surface; and

a refraction type optical system for forming a second image onto a second plane surface which is substantially parallel to said first plane surface,

wherein, said catadioptric type optical system and said refraction type optical system are disposed between said first plane surface and said second plane surface, and

wherein at least one of said first and second reflecting surfaces is a concave reflecting surface that corrects positive Petzval sum created by said lens element.

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38. (Amended) A catadioptric optical system [according to Claim 29] comprising:

a catadioptric type optical system, which includes a lens element, a first reflecting surface and a second reflecting surface that reflects light coming from said first reflecting surface, light coming from said second reflecting surface passing said first reflecting surface off-axis thereof, at least one of said first and second reflecting surfaces being a concave reflecting surface, for forming an intermediate image from an object of a first plane surface; and

a refraction type optical system for forming a second image onto a second plane surface which is substantially parallel to said first plane surface,

wherein, said catadioptric type optical system and said refraction type optical system are disposed between said first plane surface and said second plane surface, and

wherein the catadioptric optical system has both-sides telecentricity.

Please cancel Claims 41 and 43 without prejudice.

42. (Amended) A method of manufacturing a catadioptric optical system comprising [the steps of]:

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providing a catadioptric type optical system, which includes a lens element, a first reflecting surface and a second reflecting surface that reflects light coming from said first reflecting surface, light coming from said second reflecting surface passing out of an effective diameter of said first reflecting surface, [said first reflecting surface off-axis thereof,] at least one of said first and second reflecting surfaces being a concave reflecting surface, for forming an intermediate image from an object of a first plane surface; and

providing a refraction type optical system for forming a second image onto a second plane surface which is substantially parallel to said first plane surface,

wherein, said catadioptric type optical system and said refraction type optical system are disposed between said first plane surface and said second plane surface, and said catadioptric type optical system and said refraction type optical system are disposed on a single linear optical axis.

44. (Amended) A method of manufacturing a catadioptric optical system [according to Claim 42] comprising:

providing a catadioptric type optical system, which includes a lens element, a first reflecting surface and a

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second reflecting surface that reflects light coming from said first reflecting surface, light coming from said second reflecting surface passing said first reflecting surface off-axis thereof, at least one of said first and second reflecting surfaces being a concave reflecting surface, for forming an intermediate image from an object of a first plane surface; and

providing a refraction type optical system for forming a second image onto a second plane surface which is substantially parallel to said first plane surface,

wherein, said catadioptric type optical system and said refraction type optical system are disposed between said first plane surface and said second plane surface, and

wherein said catadioptric type optical system includes a lens group including at least one positive lens, and said refraction type optical system includes an aperture diaphragm.

46. (Amended) A method of manufacturing a catadioptric optical system [according to Claim 42] comprising:

providing a catadioptric type optical system, which includes a lens element, a first reflecting surface and a second reflecting surface that reflects light coming from said first reflecting surface, light coming from said second

reflecting surface passing said first reflecting surface off-axis thereof, at least one of said first and second reflecting surfaces being a concave reflecting surface, for forming an intermediate image from an object of a first plane surface; and

providing a refraction type optical system for forming a second image onto a second plane surface which is substantially parallel to said first plane surface, wherein, said catadioptric type optical system and said refraction type optical system are disposed between said first plane surface and said second plane surface, and

wherein said catadioptric type optical system includes a lens group including at least one lens element whose surface is asymmetric, and said refraction type optical system includes at least one lens element whose surface is asymmetric.

47. (Amended) A catadioptric optical system [according to Claim 42] comprising:

providing a catadioptric type optical system, which includes a lens element, a first reflecting surface and a second reflecting surface that reflects light coming from said first reflecting surface, light coming from said second

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reflecting surface passing said first reflecting surface off-axis thereof, at least one of said first and second reflecting surfaces being a concave reflecting surface, for forming an intermediate image from an object of a first plane surface; and

providing a refraction type optical system for forming a second image onto a second plane surface which is substantially parallel to said first plane surface, wherein, said catadioptric type optical system and said refraction type optical system are disposed between said first plane surface and said second plane surface, and

wherein at least one of said first and second reflecting surfaces is a concave reflecting surface that corrects positive Petzval sum created by said lens element.

48. (Amended) A catadioptric optical system [according to Claim 42] comprising:

providing a catadioptric type optical system, which includes a lens element, a first reflecting surface and a second reflecting surface that reflects light coming from said first reflecting surface, light coming from said second reflecting surface passing said first reflecting surface off-axis thereof, at least one of said first and second reflecting

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surfaces being a concave reflecting surface, for forming an intermediate image from an object of a first plane surface; and

providing a refraction type optical system for forming a second image onto a second plane surface which is substantially parallel to said first plane surface, wherein, said catadioptric type optical system and said refraction type optical system are disposed between said first plane surface and said second plane surface, and

wherein the catadioptric optical system has both-sides telecentricity.

50. (Amended) A catadioptric optical system comprising:

a catadioptric type optical system, which includes a lens element, a first reflecting surface and a second reflecting surface that reflects light coming from said first reflecting surface, at least one of said first and second reflecting surfaces being a concave reflecting surface, for forming an intermediate image from an object of a first plane surface; and

a refraction type optical system for forming a second image onto a second plane surface which is substantially parallel to said first plane surface,

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wherein, at least one of said first and second reflecting surfaces forms said intermediate image at an off-axis position, and said catadioptric type optical system [is] and said refraction type optical system are disposed on a single linear optical axis.

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